Ensuring Effective and Sustainable Radiotherapy for Cancer Treatment

VCDNP

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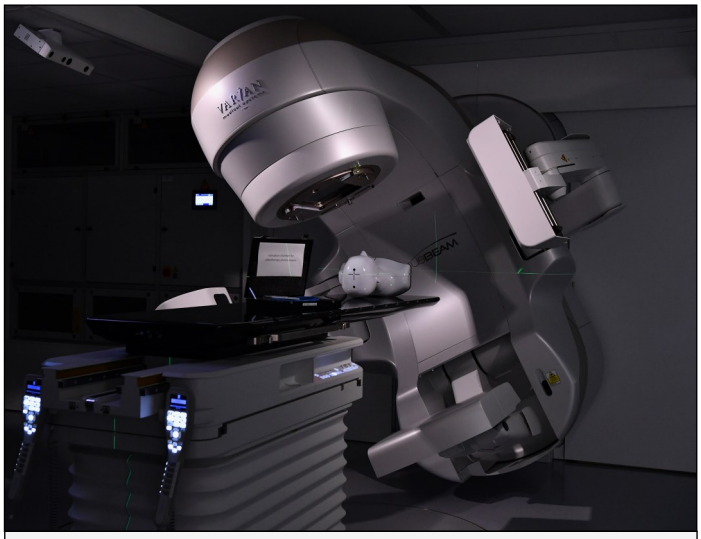
What is Radiotherapy?

Radiation therapy (radiotherapy) is a type of cancer treatment, used alone or in combination with other treatments. High doses of ionising radiation, delivered either externally (external beam radiotherapy/EBRT) or internally/in close proximity to the tumour (brachytherapy), are used to destroy cancer cells and limit cell growth. Two of the most commonly used EBRT machines are Cobalt-60 (Co-60) teletherapy units and linear accelerators (LINACs).



A LINAC presented during a tour during the opening of the IAEA's linear accelerator facility Seibersdorf, Austria on 6 June 2019. Photo Credit: Dean Calma / IAEA.

Safety and Security Concerns of Radioactive Sources

* Co-60 is the most common radioactive source used for teletherapy and is also used in high dose rate brachytherapy.
* Co-60 used in radiotherapy and Caesium-137 (Cs-137) in high-dose-rate brachytherapy are classified by the International Atomic Energy Agency (IAEA) as Category 1 or 2 sources and could cause death or injury and wide-spread panic if used in a dirty bomb or left exposed in a public place.
* An example of accidental exposure took place in May 2019 during the planned removal of an irradiator from the University of Washington in the USA. The radioactive source inside the irradiator was damaged during the move, resulting in a release of Cs-137 that contaminated 13 people and seven floors of the facility. The estimated cost of the response, remediation and building reconstruction from that incident is greater than $100 million.

Understanding Challenges to Access and Sustainability of Radiotherapy

The World Health Organization (WHO) estimates one in six deaths globally are related to cancer and that approximately 70% of cancer deaths occur in low- and middle-income countries (LMICs). Despite being home to 85% of the world's population, most LMICs have one radiotherapy machine for up to five million people. In 51 countries, independent territories and islands, cancer patients have no access to radiotherapy. In comparison North America and Western Europe have five or more machines per one million people. Obstacles in the delivery of sustainable radiotherapy services include: a shortage of machines; lack of a workforce of clinicians, nurses and support staff needed in radiotherapy clinics; the choice of technologies and suppliers; maintenance of equipment; lack of long-term planning; and lack of effective regulatory oversight.

Role of the IAEA

The IAEA supports countries in the use of nuclear and radiation medicine to fight a range of noncommunicable diseases, including cancer. The scope of the support includes resource mobilisation and the procurement of equipment, training and education, research, publication of guidance documents and in performance of quality assessments and missions. The Programme of Action for Cancer Therapy (PACT) was established by the IAEA in 2004 with the goal of ensuring the integration of radiotherapy in comprehensive cancer control and of engaging with other international organisations. The Agency has worked closely with the World Health Organization (WHO), the International Agency for Research on Cancer (IARC), the Union for International Cancer Control (UICC) and others to build a coalition of global partners committed to addressing the challenge of cancer in low- and middle- income Member States.

The IAEA has supported Zambia's cancer treatment hospital since planning began in 2002. Through IAEA support, the hospital is able to serve as a teaching centre for future generations of radiotherapy technicians. Photo Credit: Louise Potterton / IAEA.

Country Experiences

Cancer Care in Zambia

Seventy-one percent of people diagnosed with cancer in Zambia die of the disease. In 2018 Zambia had the third highest incidence rate of cervical cancer in the world. However, in the past two decades, Zambia has revolutionised its national cancer control programme to fight this trend. In 2006, Zambia established a National Cervical Cancer Prevention Programme, and in 2007 Zambian President Levy Mwanawasa opened the Cancer Diseases Hospital (CDH) which treats over 25% of Zambians. Two additional centres are planned to be built in the provinces, which should increase access to cancer care from 25% to 60%.

Political commitment at the highest level is an important factor in cancer control in Zambia. Coordination and collaboration between different government and non-governmental sectors has been critical to the sustainability of the programme. With funding guaranteed in the National Cancer Control Strategic Plan, Zambia was able to invest in capacity building in radiotherapy and radiation oncology, as well as benefit from training and advisory services offered by the IAEA. Radiotherapy at CDH is successfully administered with both a LINAC and a Co-60 teletherapy unit.

LINACs provide an optimised treatment and minimise the unintended exposure of normal surrounding tissues and organs. However, compared to LINACs, Co-60 teletherapy units are cheaper to procure and maintain, are easier to run and repair, resulting in less downtime, require less infrastructure and use less electricity. The drawbacks are more side effects from radiotherapy, security concerns related to radioactive sources, and costs related to the replacement, storage and disposal of depleted Co-60 sources.

Global Collaboration

Project STELLA (Smart Technology to Extend Lives with Linear Accelerators), established in 2016, is a unique global collaboration involving some of the best physics and medical talent, expertise from leading laboratories in accelerator design and, importantly, input and collaboration from users in Africa, as well as other developing and developed countries. Recognizing the needs of developing countries and the challenges they face using LINACs, Project STELLA seeks to work on three fronts: (1) to improve access by developing countries to radiotherapy; (2) to adapt LINAC technology to developing country conditions; and (3) to support the development of capacity for cancer control in developing countries.

Key Takeaways

* Co-60 teletherapy units and LINACs each come with distinct advantages and disadvantages, which must be considered holistically in an effective cancer control programme.
* More research and investment is required to adapt LINACs to developing country conditions.
* The building blocks for effective and sustainable cancer control include: political commitment; access to and investment in appropriate equipment; education and training of clinicians, nurses and support staff needed in radiotherapy clinics; long-term planning and effective regulatory oversight to ensure safety and security.
* Partnerships with the IAEA, WHO and other partners to support long-term planning and capacity building are essential.
* Countries should adhere to the IAEA Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, and implement the provisions contained in the Code of Conduct on the Safety and Security of Radioactive Sources and Supplemental Guidance on the Management of Disused Radioactive Sources.

For Further Reading

VCDNP Workshop on Ensuring Access to Nuclear Technology for Human Health
https://vcdnp.org/ensuring-access-to-nuclear-technology-for-human-health/

Technical Specifications of Radiotherapy Equipment for Cancer Treatment
https://apps.who.int/iris/bitstream/handle/10665/339912/9789240019980-eng.pdf/

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
https://www.iaea.org/publications/8930/radiation-protection-and-safety-of-radiation-sources-international-basic-safety-standards/

Code of Conduct on the Safety and Security of Radioactive Sources
https://www-pub.iaea.org/MTCD/publications/PDF/Code-2004_web.pdf/

Supplemental Guidance on the Management of Disused Radioactive Sources
https://www.iaea.org/publications/13380/guidance-on-the-management-of-disused-radioactive-sources/

Project STELLA: Smart Technology to Extend Lives with Linear Accelerators
https://www.iceccancer.org/innovative-radiotherapy-technologies/